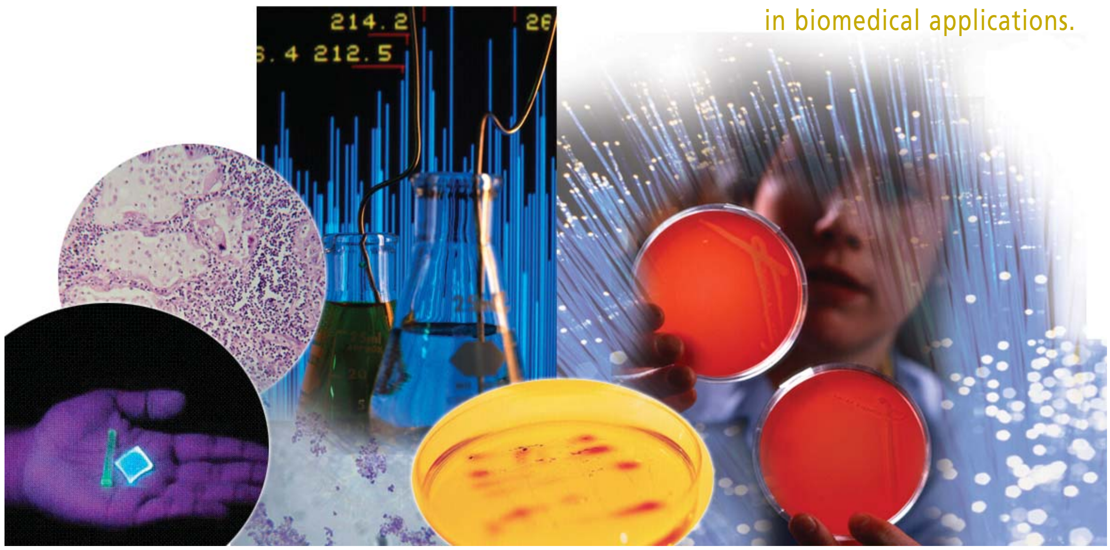
New Sol-Gel Filled Fiber-Optic Bio Sensors

NASA offers companies the opportunity to commercialize this innovative fiber-optic technology for use in biomedical applications.



NASA Goddard Space Flight Center (GSFC) has developed a new method for preparing fiber-optic devices combining chemistry and materials processing. The resulting devices have a crack-free core that can be doped to achieve specific detection properties. This sol-gel technology can be used in a wide range of medical applications, including *in vitro* diagnostics and public health detection systems.

Benefits

- ***Simple manufacturing:*** Manufacturing process is straightforward and low cost.
- ***Near-room-temperature processing:*** Since temperature-sensitive dopants can be used, a wide range of sensitive biological and biochemical materials are available.
- ***Versatility:*** Multiple sol-gel-filled units can be bundled so that fiber acts as a sensor and reaction substrate; units can be combined with other fiber-optic sensors.
- ***Portability:*** Units are lightweight, durable, and require little power and space.
- ***Adaptability:*** Specific core properties are controllable by selection of dopant; units can be used single-ended or in-line; can provide substrate for reactions and catalysis, and can become platforms for observing and controlling reaction kinetics.
- ***Improved sensor performance:*** Increasing the dopant material improves sensor performance; increasing the sensor reagent increases amplitude of detection signal.
- ***Robustness:*** Units are not susceptible to interferences from endogenous materials.
- ***Disposability:*** Units are very low in cost and are intended for disposable use.
- ***Lasting applicability:*** As long as fluorescence can be used, units with new materials can meet changing sensing needs, eliminating obsolescence.

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The Technology

Existing sol-gel fiber-optic units coat optical fibers with sol-gel and experience the drawback of detection occurring outside the fiber rather than inside. Researchers at NASA Goddard Space Flight Center have incorporated sol-gel as a core element rather than as a coating on fibers. This technology is a method for fabricating a fiber-optic device, ensuring that sol-gel's emitted luminescence or fluorescence is transmitted directly to the detector. It involves integrating the sol-gel into a hollow-core optical fiber following these basic steps:

1. Identify the condition to be monitored.
2. Identify the appropriate sol-gel for the specific condition.
3. Chemically fabricate the sol-gel and introduce the appropriate dopant.
4. Inject the sol-gel into the hollow core fiber.
5. Cure the sol-gel inside the fiber to create the probe.
6. Attach the probe to a communications fiber-optic waveguide. The probe is ready for use.

Why it is better:

Sensors offer a fast response time and sensitivity several orders of magnitude higher than that of existing sol-gel detector technologies.

Many sol-gel-filled fiber-optic units can be bundled for custom applications where the fiber acts as sensor and reaction substrate. Sol-gel fiber-optic units can be used single-ended or in-line, as required by the application. The resulting fiber-optic sensing units possess all the beneficial characteristics of typical fiber-optic sensors and sol-gels.

Sol-gels can be tailored to obtain specific electrical and optical properties. By carefully selecting dopants, a wide range of sensing responses can be achieved.

GSFC researchers have demonstrated that sol-gels can be doped with highly pH sensitive fluorescent dyes, while retaining their sensitivity. They are currently working on sensors for monitoring an alkaline phosphatase reaction.

Commercial Applications

- *In vitro* diagnostics of physiological analytes and other body chemistry
- Monitoring of drug dosage/concentrations and blood constituents
- Rapid detection of bacterial infections/contamination
- Detection and monitoring of chronic diseases and critical biomarkers
- Biological sensing or monitoring (i.e., using luminescent materials for chemical, pressure, or temperature sensing or stress monitoring)
- Detection of phosphatases and measurement of phosphatase activity (i.e., in detection of cancer and biochemical processes in cells)
- Screening combinatorial chemistry libraries to accelerate discovery of new pharmaceuticals
- Interventional cardiology to assess risk of subsequent coronary occlusion or pathological bleeding periprocedurally
- Sigmoidoscopy and colonoscopy
- Improved cancer chemotherapeutic drug delivery (i.e., providing the optimal dose of drugs at the tumor site)
- Chemical contamination surveillance (i.e., tracking levels of chemical warfare agents in the air)
- Forensic analysis

Partnering Opportunities

This technology is part of NASA's technology transfer program. Companies are invited to consider partnering with NASA to implement the sol-gel technology in biomedical applications.

For More Information

If you are interested in more information, or want to pursue transfer and commercialization of this technology, please contact:

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